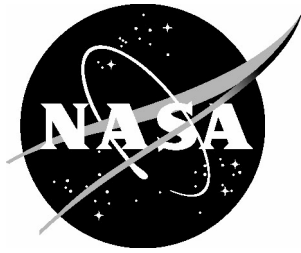


NASA/CR-2005-213275



An Assessment of the Effectiveness of the AGATE Program Management Model

Paul Masson

Strategic Alliances Resources Network, LLC, San Francisco, California

July 2005

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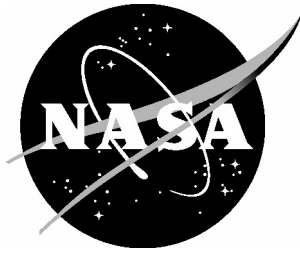
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Preface

This report describes the structure and effectiveness of a NASA program that replicated a private sector research and development partnership model. The partnership is described as an “alliance” as it included a large number of participants organized into work-teams.

The concept in adopting the alliance was very simple: to gain the same efficiencies in program management that are realized in private sector alliances, namely improved outcomes at a lower cost with better customer satisfaction.

Private sector management concepts, however, rarely translate readily into public sector activities. Our system of government management reflects the broader ebb and flow of public policy regarding the Federal government role, and how bureaucracy provides for the public good. The introduction of alliance management models into the Federal government must deal with four broad trends in federal management philosophy.^a

- Scientific management with its focus on tight hierarchy, chains of command and specialization
- War on waste with its emphasis on inspectors, auditors and reviewers
- Watchful eye with its embrace of sunshine and openness
- Liberation management with its cry to let the managers “manage” with some market pressure

Alliance models cut across all four trends. Alliances contain a form of structure that provides for hierarchy and chains of command. Equally, they contain internal audit processes and constant peer review of both cost and output, invoking a level of knowledge above that of an outside auditor. While alliances can provide some form of liberation from traditional management processes, that liberation is offset with rules regarding joint decision-making.

So if alliances contain all these elements, almost the best of all worlds, why are they not more readily used? Simply put, because they are customized business arrangements that satisfy a particular strategic or program need. And, the very nature of customization means that alliances must be carefully designed to be effective in meeting stakeholder expectations. Those expectations are measured by asking “participants” whether the alliance met its performance objectives, and how favorably that experience compared to other business vehicles.^b

^a Paul Light, *The Tides of Reform: Making Government Work 1945-1995*, Yale University Press, New Haven, CN, 1997.

^b Accenture Consulting Study, *Management Review*, American Management Association, Page 7, January 2000.

Executive Summary

Background

This report describes the collaborative program model chosen to implement an aeronautics research and technology program from 1994 through 2001: the Advanced General Aviation Transport Experiments (AGATE) Program. The Program had one primary objective: to improve the ability of the General Aviation industry to adopt technology as a solution to fulfill public benefit objectives. The program was launched in response to the widening gap between the national need for improvement in the safety and performance of general aviation aircraft, and the inability of the General Aviation industry to adopt new technology for those improvements.

Objective

The primary objective of this report is to assess the program's ability to meet a combination of "effectiveness measures" from multiple stakeholders. The "effectiveness" of any model forms the foundation of legitimate questions for policy makers and professional federal managers. Within this context, it is the objective of this report to determine how such models can be assessed for their effectiveness by focusing on four questions:

- What basic NASA R&D program model did AGATE follow? "
- What tailoring was done for the particular AGATE program model?
- What criteria were applied to assess the effectiveness of the tailored AGATE program model?
- How well did the AGATE program perform relative to those criteria?

Scope and Sources

Information about the effectiveness of the AGATE program model were drawn from five sources: a) AGATE Closeout Reports authored for all six (6) of the "technical teams" covering the public and private members, b) interviews with a total of twenty-six (26) NASA program managers, AGATE private sector members, and independent policy analysts, c) results of four (4) "commercialization" performance surveys conducted from 1996 through 2000, d) results of nine (9) performance audits undertaken by an independent auditor, and e) the results of one independent NASA OIG review of the program.

AGATE Program Model

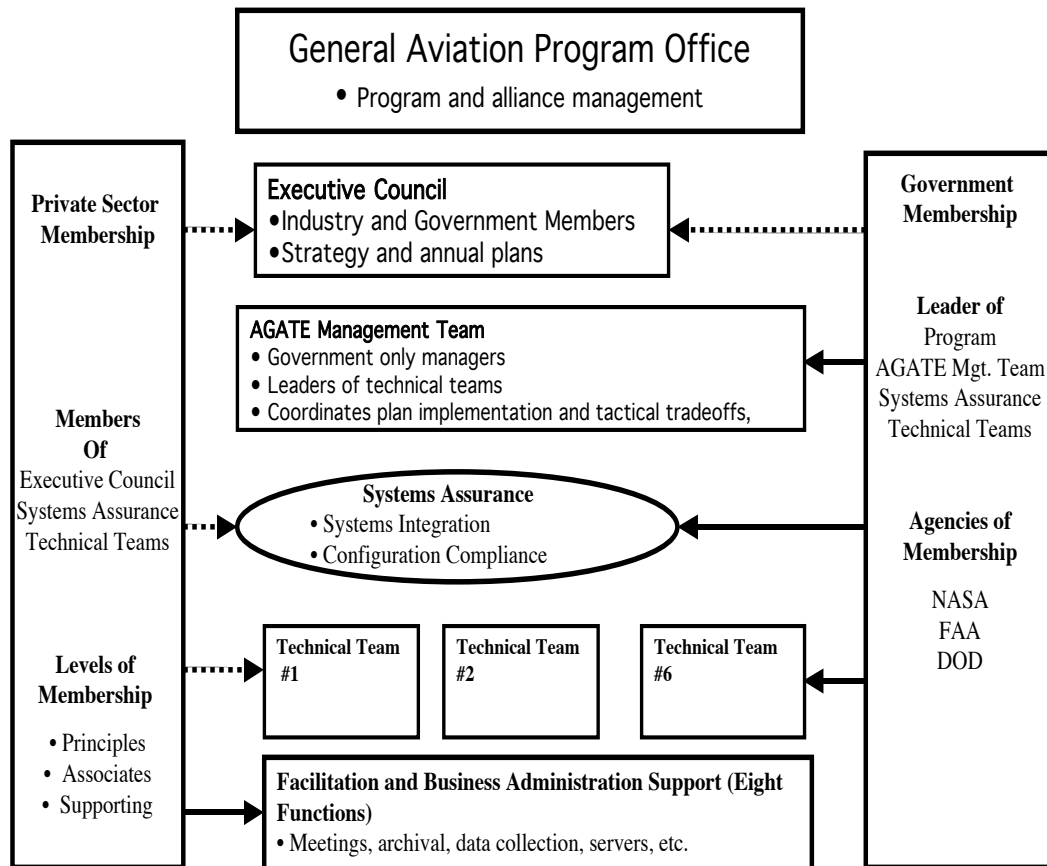
AGATE was organized as a public/private partnership, focused on standards development. The partnership was "horizontal" in nature, with competitors collaborating to create "pre-competitive" standards. Public and private members joined into working teams that set strategy and selected specific research topics. The alliance was under the overall management of NASA as the "senior partner."

The final integrated organizational structure was a hybrid of basic project command and control structures, with layers of working groups to coordinate decisions. NASA took the leadership role at each level, except for basic facilitation and business administration, while industry took a "membership" role at each level. The organization had six components:

- General Aviation Program Office (GAPO)- The NASA program office staffed by the Program manager, a deputy and secretary. GAPO was the overall "alliance" manager and had final authority to approve all plans.
- Executive Council- Composed of elected representatives from industry technical teams and designated government representatives. The Council's primary function was to agree on strategy and priorities.
- AGATE Management Team- Composed of the GAPO personnel and government technical specialists that led six technical working teams. The Management Team's primary function was to assure coordinated implementation of the annual plan.
- Systems Assurance- Led by a Government specialist and composed of industry members representing each of the technical working teams. The Systems Assurance team's primary

function was to support systems integration across technical teams and assure work was done to overall “configuration management.”

- **Technical Teams-** Led by Government specialists and composed of industry and academic members. These were the basic organizational unit that prepared and executed annual technical plans to achieve the program’s objectives.
- **Facilitation/ Business Administration-** Led by private sector managers, this function was delivered through by a non-profit private sector entity, and funded by both the public and private sector. The facilitation function acted as a good-faith intermediary between the public and private sector members. The business administration function provided eight basic services necessary for a partnership-based program.



Legend: Dashed line indicates membership only
Solid line indicates leadership and/or authority

Assessment Framework

There were four levels of effectiveness that applied to the AGATE Program over its lifetime of planning and implementation:¹

- Policy- Major principles that guide the justification all Federal programs.
- Department/Agency Strategy- Strategic goals to be accomplished or supplemented by all Agency programs.²
- Large Organizational Unit- NASA Center (Langley, Ames, Glenn) level measures including their respective charters, and management system requirements.
- Program- Measures specific to a specific program (e.g. aeronautics knowledge advancement).

There were eight measures of effectiveness that were applied to the AGATE program.³ These measures were compiled from management initiatives launched over the past four administrations.

- Performance- Creation of measurable goals to be achieved through program plans, organization structures, and management structures with high quality, on schedule and within budget.
- Public Benefit without Private Preference- Creation of program outputs designed to generate benefits to the American public without subsidy to private participants or control of the outcome by a limited number of organizations.
- Relevance- Definition of goals and objectives relevant to customer/user groups.
- Speed- Generation of results quickly and in forms that can be readily adopted by customer/users.
- Accountability- Creation of organizational structures with clear responsibility and monitoring systems tied to specific performance measurements. The structures and systems hold program and task level managers accountable for all Levels of objectives.
- Cost- Reduction of costs in all categories of program content and management.
- Flexibility- Use of legal authorities, organizational structures, and decision processes to respond to changing needs from policy, management, and research & development finding.
- Institutional Development- Development of institutional capacity for further research and development support. Development of these capacities includes improved human capital, facilities, and new knowledge.

The cumulative program effectiveness measures generated at different levels of oversight created a single model for the AGATE program effectiveness measurement. The format is designed to mirror the evolution in performance measurement summaries developed under the last two administrations.^{4 5}

¹ Derived from interviews with Bruce Holmes, Sam Morello, and David Trinkle (OMB)

² NASA Strategic Management Handbook, as revised NPG 1000.2, Washington, DC, 2000

³ A Report to the 43rd President and 107th Congress: Transitioning to Performance-based Government, November 2000

⁴ 5th Year Report on Re-Inventing Government, Brooking Institution, Washington, D.C., 1998

⁵ Program Assessment Rating Tool (PART) explanation, provided by David Trinkle to Paul Masson for interview.

MEASURES	Qualitative Rating (Hi/Med/Low)	Feedback from Participants of Effectiveness regarding Policy, Strategic, Organizational Unit and Program/Project Levels
Performance		
Relevance		
Benefit w/out Preference		
Accountability		
Cost		
Speed		
Flexibility		
Institutional		

Summary of Effectiveness Conclusions

The participants rated AGATE as achieving its primary objectives and rating well on effectiveness in most areas. There was a clear pattern of tradeoff, with high measures for relevance, cost, speed and public benefit, but lower measures for institutional fit and flexibility at dealing with the larger NASA organizational structure. This tradeoff reflects similar patterns of tradeoff found in private sector surveys of alliances and partnerships.

The effectiveness measures were assessed against the program's stated goals. There were several "stretch" goals, in particular integrated flight tests that would represent the evolution of the technology integration. The area of stretch goals is where the participants rated AGATE lower. Most participants recognized that the lack of integration was a tradeoff for a desired "decentralized" approach permitting work teams to operate independently on selecting specific technology targets.

The business managers at NASA rated the program medium to low, focusing on the difficulty of implementing a program structure that contained more tailoring than most NASA LaRC programs.

The summary of effectiveness responses is provided in the following table.

Summary of Effectiveness Measure Feedback

MEASURES	Qualitative Rating	Effectiveness at Policy, Strategic, Organizational Unit and Program/Project Levels
Performance	High	Performance was achieved at all levels. The decentralized structure of the alliance made it difficult to achieve a “stretch goal” of integrated flight tests.
Relevance	High	The relevance of program/project outputs scored high by the industry end-users and the FAA partners. Disagreement over relevance was limited to specific technology targets rather than the overall program/project approach.
Benefit w/out Preference	High	Public benefit without private preference scored high with all participants due to the focus on creation of technology standards rather than specific technologies.
Accountability	Medium	Accountability was achieved at the Policy, Strategic Levels. Financial accountability was achieved at the Center and Program level, but technical accountability was reported as inconsistent for some of the work-teams at the program/project level. This inconsistency at the program/project level created questions of accountability at the Center level.
Cost	High	The cost effectiveness was considered high at all levels. The program secured cost sharing from private sector partners and organized highly effective leveraging agreements with other NASA programs (SBIR) and the FAA.
Speed	High	The speed of tasking and undertaking work was considered high, when compared to other Federal program/project forms. The speed of program “formulation” was the only negative rating. This was attributed to the need to secure “agreement” with partners before proceeding.
Flexibility	Medium	Flexibility was achieved at the Policy, Strategic and Program/Project levels. Changes in national priorities, NASA’s strategy and project targets were incorporated into the program. This flexibility, however, caused difficulties at the Center level need for consistent program/project management.
Institutional	Low	The program did not work within Center level institutional structures nor build further research and technology competencies. Center level business managers found the program difficult to implement and potentially risky due its particular form of accountability management.

BACKGROUND

Few things can better serve managers undertaking leadership roles in large, complex, technology-based organizations than knowing how other such organizations have coped with the problems that must be solved to achieve success.⁶

AGATE Program: A Collaboration with the General Aviation Industry

This report describes the collaborative program model chosen to implement an aeronautics research and technology program from 1994 through 2001: the Advanced General Aviation Transport Experiments (AGATE) Program. The Program had one primary objective: to improve the ability of the General Aviation industry to adopt technology as a solution to fulfill public benefit objectives. The program was launched in response to the widening gap between the national need for improvement in the safety and performance of general aviation aircraft, and the inability of the General Aviation industry to adopt new technology for those improvements.

Collaboration Embedded Within NASA's System

The range of NASA mission's drives a fundamental need for the Agency to engage in collaborations of all scales and types. A large academic research community and cadre of contractors has become a permanent part of the Agency's resource pool. A wide range of contracting and cooperative agreement authorities have been standardized along with selected use of NASA's Space Act Authority. This accumulation of effort and tools represents the evolution of a "collaboration system" reflected in different program models available to NASA managers.

Evolution of the Collaboration Culture

The genesis of NASA's collaboration culture is based in the operating practices of NACA, the aeronautics agency that absorbed multiple rocket programs to create the current day NASA. The aeronautics agency held annual "industry engineering conferences" meetings from 1931 to 1939 with industry groups to identify commonly needed aerodynamic design requirements.⁷ An extension of this "common approach" led to the practice of industry collaborative use of NASA's wind tunnel system.

This foundation was expanded with the space program to add the "contractor model" and its supplemental network of academic research. This provided the agency with a steady flow of internally and externally generated research, integrated by contractors into programs directed by NASA civil servants.

⁶ Arnold Levine. Managing NASA in the Apollo ERA. NASA Special Publication # 4102, National Aeronautics and Space Administration, Washington, DC, July 1972.

⁷ Roger Bilstein. Orders of Magnitude: A History of NACA and NASA: 1915 to 1990. National Aeronautics and Space Administration, Washington, DC, 1989.

Evolved Structure of Collaborative Models

The evolution of the collaborative culture has continued in recent years, with new forms of collaboration designed to copy private sector management methods. When combined with NASA's original collaborative culture, it provides a basic array of options for managers when faced with collaboration requirements:

Table 1
NASA Collaborative Approaches

Collaborative Category	Features of the Collaboration
Research exchanges	Informal cooperation, often with academic community, resulting in co-authored papers
Joint data generation	Formal agreements for data generation, often with aeronautics companies, using Wind Tunnel agreements
Contractor arrangements	Formal goods and services acquisition, structured with a high level of personal collaboration among participants generating a "team"
Program/Project Partnerships & Alliances	Formal structuring of cost and results shared projects; resulting in joint project plans, controls and output sharing
Privatization	Transfer of assets to private sector control, in return for ongoing Federal use, resulting in a sharing of operations vs. asset ownership risk
Outsourcing	Transfer of basic functions to contractor outsourcing, but maintaining a close working relationship between the core NASA managers and their outsourced managers

General Aviation Industry: A Slow Loss of R&D Capabilities

General aviation refers to the smaller category of aircraft used for personal, small package, and business transportation. The general aviation industry is composed of companies that manufacture the aircraft, schools that train the pilots, and airport service operators known as "fixed-base-operators." The entire industry is regulated by the Federal Aviation Administration (FAA) to assure safety of planes, pilots and their operation in the national air space. The process of regulating the safety of individual aircraft takes the form of a detailed review of any new equipment or planes proposed for sale by a general aviation manufacturer. This review process results in a "certification" of the plane's safety and the manufacturer's ability to begin full-scale production for sales.

The lack of technology adoption for new general aviation product improvements was caused by a series of factors. The high costs of product liability coupled with uncertain certification costs for new technology caused many companies to slow the rate of product improvements. The advancement of information technology into large aircraft could not migrate into the smaller aircraft for lack standards. While many small companies developed new technologies, few had the resources to overcome both the certification process and assure standards compatibility with other suppliers.

These conditions combined in the industry to divert resources away from research and development. As the internal technical capabilities of the industry shrunk, their ability to readily adopt externally generated technologies declined. Industry leaders recognized the absence of technology-based innovation, but no single company or trade association could muster the support to launch an industry-wide effort to comprehensively deal with the issues of certification and industry standards.

AGATE Program Formulation: Rebuilding R&D Capabilities and Links

The AGATE Program was launched in 1994 based on seven (7) recommendations generated by a General Aviation Task Force composed of government, industry and academia.

Four recommendations focused on where to revitalize the research and development capabilities of the industry:

- Propulsion, Noise and Emissions- Evaluate technologies that will permit the aircraft to operate quieter, with fewer emissions, using and using less fuel while meeting environmental standards throughout the world.
- Aeronautics Systems- Introduce new technology in the cockpit to enhance pilot training and improve aviation safety.
- Structures and Materials- Transfer available NASA information on advanced metallurgic and composite materials to the private sector.
- Aerodynamics- Introduce technology for greater efficiencies in vehicle speed, carrying capacity, and fuel consumption.

Two recommendations focused on re-starting general aviation research at NASA, which had been terminated in the mid-1980's. The final recommendation focused on considering use of collaborative models to implement the program.

Program Management Options

The program manager considered five fundamentally different ways of designing the AGATE Program management approach, given the practices and authorities that existed at NASA between 1992 and 1995.

In-House Model- *NASA in-house research, technical reports & demonstrations-* Develop and execute a research and demonstration program focusing on in-house research and technology competencies. The research is organized by topical area of expertise. Each expertise area leader chooses the mix of civil servant and contractor expertise to complete and deliver research results. The results are distributed publicly via papers and symposia.

Competitive Procurement Model- *Procure a demonstration plane-* Develop and demonstrate an advanced aircraft working with a contractor secured via a competitive procurement. The contractor will disseminate knowledge through demonstration and public distribution of papers.

University Research Model- *University led, industry research, technical reports-* Develop and demonstrate individual technologies working with broad based industry teams working under university leadership. The teams are organized by research topic and disseminate knowledge through joint project work and public distribution of papers at symposia.

Industry Partnership Models

1. **Vertically integrated, demonstration focused-** Develop and demonstrate individual technologies working with an industry team that represents the "supply chain hierarchy." The team works according to a single plan intended to create an integrated "aircraft". The plan is agreed to by a standardized "industrial cooperative agreement", led by a "prime" integrator, and overseen by NASA managers. Knowledge is disseminated informally between team members and formally through sharing of intellectual property rights.
2. **Horizontally organized, standards focused-** Develop common technology standards and systems architectures with broad based industry teams that represent competitors within multiple industry sectors. The teams work according to mutually agreed upon technical plans. NASA manages the partnership toward strategically agreed upon targets. Knowledge is disseminated informally between team members working project work, and formally by jointly proposing standards. The intellectual property behind new standards is jointly held and shared among all team members for a limited period of time and then released to the public.

Program Management Strategic Issues: Four Issues Limit Management's Options

The AGATE program planning managers also faced a number of unique strategic issues in formulating the program plan. These issues required the managers to determine if and where traditional program management models would have to be changed.⁸

The first issue was NASA's lack of general aviation focused research capability as a result of a decision in the mid-1980's to de-emphasize such work. This had resulted in a lack of facilities access and personnel in areas such as computer simulation capability, engine test cells, and material property labs. The career interests of NASA personnel reflected this previous policy change, resulting in a scattered network of researchers interested in general aviation work, but no critical mass capable of undertaking a comprehensive program.

The second issue was the need to make a wide industry impact, without providing preference to any a small group of companies. Within this issue was the challenge of how to incorporate new, startup general aviation companies with innovative product ideas, but lacking the capital and track record to complete the certification process.

The third issue was the size of funding, which was capped at \$69 million over an eight (8) year period. The size of funding relative to the breadth of desired technical standards meant the program would have to make difficult tradeoffs and find some way to lever small investments into industry wide impacts.

The fourth issue was the gradual shift in expectations for federal program management and performance, which was translating into changing expectations of the effectiveness of the program. These changing expectations were the result of multiple government management reform initiatives: the Reagan Administration initiative focusing on Government reforms to cut bureaucracy and promote international competitiveness (Grace Commission), the Bush Administration actions to bring about performance based budgeting through the Government Performance Results Act (GPRA), and the Clinton Administration initiative to Re-invent Government primarily through force reduction, procurement reform, and some degree of new authorities.⁹ The trend of changes facing the program managers is summarized in Figure 2.

Figure 2: Shift in Federal Program Principles Over Four Administrations

Category	Previous Principle	New Principle
Activity Purpose	Process Based	Performance Based
Activity Measure	Volume of Activity	Relevance to User
Timeliness	Timeliness (Speed) Secondary to Fairness and Thoroughness	Timeliness (Speed) Equally Important as Fairness and Thoroughness
Accountability	Internally Defined Measures	Externally Defined Measures and Relevancy
Cost	Based on Budgets and Federal Market Cost Comparisons	Based on Unit Efficiency and Private Sector Market Cost Comparisons
Flexibility	Changes Permitted Only within an Existing Rules Based System	Changes Created As Necessary to Achieve Objectives of Program and Needs of Users
Benefit	Public Benefit Achieved by Open Dissemination of Information and Winner-Take-All Contracts	Public Benefit Achieved by Dissemination with American Preference and without Winner-Take-All Control of Results

⁸ Advanced Subsonic Program Element Plan, NASA Langley Research Center, Hampton, Virginia, July, 1993

⁹ 5th Year Report on Re-Inventing Government, op. cit.

Horizontal Partnership Model: Closest Fit to Objectives and Strategic Requirements

The NASA AGATE Program planning manager chose a partnership model organized into six key technical teams focused on standards development. The model was tailored to add competitive processes to supplement the collaborative processes. This decision was consistent with the GA Task Force's final recommendation, to form some type of public/private partnership for the program.¹⁰ The decision also addressed the strategic issues facing the program managers:

Lack of Focused Research: Increase Industry Participation and Output Relevance thru Tech Transfer- The managers chose close partnering with industry on specific technical tasks to increase the level of relevant technical work, thereby increasing technology transfer. The technology transfer research indicated that technology transfer from standard in-house research and university programs was too slow and often disconnected from the relevance of user needs.¹¹

Lack of Resources: Require Industry Cost Sharing and Link in Other Federal Programs- The program was funded at the equivalent of \$8 million a year and faced an industry whose research and technology base was continually shrinking. The program required 50-50 cost sharing of all research tasks with private sector members. The managers sought resource-sharing projects with other NASA programs, the FAA, industry and academia.¹² Such arrangements would increase the speed of adoption if they involved customers and end-users.

Influenced Industry Wide Standards: Create Public Benefit Thru Standards without Private Preference- The managers sought to raise the research and development capabilities of the General Aviation industry without giving preference to a particular company, investment group or technology. The managers also sought to avoid the experience of a "winner-take-all" result from competition for a demonstration plane.

Shifts in Federal Priorities and Management Policy: Build in a Constant Change System- The managers anticipated changes in federal policy, GA research priorities, and NASA management practices. They also anticipated that research would prove some paths unworthy of further investments, and open new paths for technology development. The managers sought to build in change at all levels: strategic, management methods, systems engineering and technical research. The managers sought change at a level where they could balance collaborative and competitive processes according to the need of the technical work.

The result of the Manager's choice was the formation of an alliance including multiple NASA centers and units, the FAA, academia and industry all coordinated through a form of centralized alliance functions. The fundamental concept and structure of a broad decentralized collaboration was not new to NASA, but the specific structures, processes, and business terms were unique in the Agency's recent history. Given that uniqueness, the Managers planned a post-project assessment of the effectiveness of this particular program management model.

¹⁰ General Aviation Task Force Report, pg. 47, op. cit.

¹¹ Paul Masson, Meeting National Priorities: NASA's Mission to America, Pgs. 4-8, PMA, San Francisco, CA, 1989.

¹² Advanced Subsonic Program Element Plan, op. cit.

OBJECTIVE AND SCOPE

Objective

The objective of this report is to describe the program management model of the AGATE program, and assess its ability to meet a combination of “effectiveness measures” from multiple levels of stakeholders. The report focuses on four questions:

- What basic NASA R&D program model did AGATE follow? ”
- What tailoring was done for the AGATE program model?
- What criteria were applied to assess the effectiveness of the tailored AGATE program model?
- How well did the AGATE program perform relative to those criteria?

Scope and Sources

The definition of NASA technology program management models was drawn from the NASA (Headquarters and Langley) guidelines on management, program management documents, and interviews with line managers. Primary emphasis was placed on NASA’s formal guidance for program and project management: NASA Policy Guidance 7120.5 (A &B) Program and Project Management Processes and Requirements. Interviews were conducted with NASA managers to define the status of NASA program planning between 1992 and 1995.

The sources of information about the AGATE Program design and business model objectives were drawn AGATE Program plans and management guidelines issued during the Program. In addition, the report author participated in the AGATE Program design in 1993 and its implementation through 2001.

The definition of fundamental Federal technology program management effectiveness criteria was drawn from a review of policy guidelines, program directives, and position papers from the Executive and Legislative Branches covering the last four Administrations.

Information about the effectiveness of the AGATE program model was drawn from five sources: 1) AGATE Closeout Reports authored primarily by private sector and academic participants, 2) interviews with NASA managers and private sector counterparts, involved in the alliance management structure, 3) results of annual “commercialization” performance surveys conducted from 1996 through 2000, 4) results of annual performance audits undertaken by an independent auditor, and 5) the results of an independent NASA OIG review of the program.

The report is designed for a reader with basic familiarity of NASA’s aeronautics program history, the General Aviation industry, and the fundamental models for technology collaboration.

METHODOLOGY: R&D PROGRAM MODEL & AGATE TAILORING

The Basic Model: NASA's R&D Program Model

The AGATE program was designed on the NASA program model operating in the early 1990's. That basic "model" included a practice that provided for "tailoring" a program to the particular mission needs.¹³ Based on that permission for tailoring, the AGATE program design was composed of three parts:

Policy Level- The creation of objectives and accompanying structures to assure the program met national needs and was linked into the Agency's strategy

Management Level- The conformance to NASA's program management preparation processes and creating systems to assure the program can be managed effectively.

Tailoring for Partnering- The tailoring of program planning processes and management systems to address partnering issues. The AGATE program tailoring followed a systemized process created for structured program partnerships, and supported through a standing NASA commercialization program known as the Joint Sponsored Research Program. (See Tailoring and JSR Program)¹⁴

The Policy Level: Clear Need, Strategy, Management and Results

The AGATE Program managers addressed policy issues working with NASA senior management and the General Aviation Task Force.

Federal Purpose: Multiple Reasons to Revitalize Technology Development Process- The AGATE program was initially launched to support Federal policy goals of improving U.S. international competitiveness.¹⁵ The policy basis for improving U.S. competitiveness was developed by the Grace Commission during the Reagan administration. The GA Task Force identified additional policy needs for improving industry R&D, including anticipated improvements to aircraft safety, enhancement of noise control, and creation of the potential for new transportation systems. The research and concept formulation of such a new transportation systems was completed within the first two years of the program.¹⁶

NASA Strategy Fit- The AGATE program fit within NASA's Advanced Subsonic Program as a minor element. While the strategic fit was logical within the purpose of NASA's subsonic research, it did not have a strong strategic fit with other programs addressing large-scale aircraft. However, NASA was the only entity within the country with the critical mass and capability to re-create R&D links between the General Aviation industry and the research community.

Management- The Task Force concluded that the program should be managed as a "partnership" between NASA, FAA, industry and academia. NASA was to act as the senior partner, and responsibility and authority for final decisions on most critical issues.¹⁷

Results- The Task Force and planning managers agreed that the results should be tangible, but not targeted to the benefit of any one company. Furthermore, they agreed that the results could not act as a "subsidy" to the general aviation industry but rather solve the structural problems that impeded current R&D from flowing into the industry.

Management Level: Follow NASA's R&D Program Model

The AGATE Program followed the basic NASA management model in place in the early 1990's, but at a formal level designated as a "project" rather than a "program."

¹³ Program/Project Management, NASA Management Instruction (NMI) 7120.4 per interviews with John Newcomb and Howard Robbins.

¹⁴ Joint Sponsored Research, Program Information Package (PIP), reference NASA NPD

¹⁵ GA Task Force Report, Page 12-13, op. cit.

¹⁶ Small Aircraft Transportation System Concept for the AGATE Project, AGATE Workpackage 12, Report 12-002, July 1996.

¹⁷ GA Task Force Report, pages 44-51, op. cit.

This designation has significance in the level of preparation and systemization for a given activity within NASA. Programs are higher-level groups of activities within organizational units known as Enterprises. Projects are smaller scale groups of activities within programs. The early 1990's model required both programs and projects to have clearly defined goals, objectives, requirements, and financial commitments. So, while AGATE was referred to as a "program", it actually was planned and initially operated under the "project" structure of NASA's system. The project structure permitted the program to be broader in its plans and leave more room for future tailoring. Both programs and projects, however, must complete the same basic series of planning elements.¹⁸

Process and Functional Requirements

- **Program Formulation**- The AGATE program formulation was prepared first by NASA managers, and subsequently in collaboration with a cross section of industry and academia that agreed to "partner" with NASA in the targeted technical areas. Program formulation addressed issues including program planning, systems analysis, technology readiness, commercialization, business opportunities, infrastructure, and knowledge capture/technology transfer.
- **Program Approval**- The program was reviewed and approved within NASA as an element within the Advanced Subsonic program. Its "readiness" to proceed was determined to be the readiness of industry partners prepared to collaborate with NASA.¹⁹ Once that readiness was deemed acceptable, NASA management approved the program.
- **Program Implementation**- The program execution was originally designed to operate on a centralized basis through the General Aviation Program Office (GAPO) with operations support of the Program Controls Branch (PCB). Program implementation support procedures were to be designed by PCB based on the Langley Management System (LMS). This method of implementation was chosen in lieu of a JSR proposed method that would have generated a Program implementation "manual" designed to provide detailed guidance about the contents of the customized legal agreement driving the partnership, rather than the LMS. A scaled down version of this JSR "implementation manual" was generated as the Business Operating Handbook. (See Tailoring)
- **Program Evaluation**- The program evaluation evolved in two stages. The first stage involved application of NASA's internal program milestone management and review process. The second stage evolved through an annual "measurement" of the program effectiveness in terms of its ability to generate research that would lead to industry standards to support commercialization.

Management Requirements

- **Human Capital**- The mix of human capital was the most difficult issue faced by the program. The absence of previous General Aviation work at Langley left a dearth of individuals with both interest and knowledge. The R&T competency managers received feedback that GA work was not the "type" that attracted their personnel.²⁰ The mix eventually was solved by securing NASA and FAA personnel to lead teams of private sector partners organized into one of six technical areas. In addition, contractors were used to support Program Management functions. Finally, a separate individual was placed as a "facilitator" working with both the Government and industry partners to act as a "good faith intermediary."

¹⁸ NASA has clear policy for this model (NASA Program/Project Management (NPD 7120.4B) and Project Management Process and Requirements (NPG 7120.5B)) and management development programs (NASA Academy of Program and Project Leadership-APPL).

¹⁹ See milestone #1 on AGATE Program Plan, 1994

²⁰ Interview with Doug Dwoyer

- Resources Management- The resources were planned and managed through a top-down, and bottom up process. Six separate technical teams prepared annual “resource plans” which were presented bottom up to a Executive Council. The Council matched the bottom up requests against top-down program budgets available for the year. A final budget was then proposed by the Executive Council to NASA reflecting that year’s priorities. Incorporated in this process was life cycle cost (LCC) management and program accounting. AGATE program required all research tasks would be “cost shared”, with 50% from the private sector partner and 50% from NASA. NASA used a customized monthly financial report to track use of both NASA and private sector resources committed to a given ask.
- Risk Management- The program faced a limited number of scientific and operational risks. However, it did face some “performance” and “flight safety” risks. (See below)
- Performance Management- The program created annual technical plans with detailed tasks, milestones and deliverables. These were combined into a master performance management plan, which evolved into a masterwork schedule. Authority to modify the schedule was in the hands of the appropriate Federal manager, depending on the level of milestone to be achieved.
- Acquisition Management- Acquisition management was not applicable in the traditional sense, since NASA was not acquiring goods and services, but rather cost sharing with private sector partners. The majority of the program resources were deployed through funded Space Act Agreements, with a minority through traditional contractor structures to support Program Management.²¹
- Safety and Environmental Management- The program faced safety risks with flights, but no environmental risks. The private sector partners, using their own aircraft and facilities, however, undertook all flights. NASA’s standard Safety Review Board structure and process was modified to recognize that the risks were borne by private sector members only. A new safety Board was created under the coordination of a NASA civil servant and composed of representatives from the companies responsible for executing individual flights. This “blended” approach evolved into the Executive Safety Review Board (ESRB) with policies regarding airworthiness and flight safety procedures for the program.²²
- Security, Export Control and Foreign Involvement- The program had no overt security issues. Export control was executed by requirements of partners within the business agreement to control transfer of technology abroad. Foreign involvement in the project was prohibited by terms of the partnership agreement.²³

Tailoring for Partnering

The early 1990’s NASA practice encouraged managers to “tailor” their program plans to meet their particular mission needs. This practice later became codified as an explicit element of planning, when NASA updated its formal guidance for program planning and included “tailoring” as one of nine themes to guide NASA program managers. The core objective of tailoring was to maximize the ability organize and allocate resources as needed.

²⁴ While the NASA Program Manager, Bruce Holmes, had determined to tailor the program plan to incorporate “partnerships”, he was left with the question of the right “partnership model” as the beginning point for such project formulation.

Partnership Based Models: Joint Sponsored Research Program

The Associate Administrator (AA) for Aeronautics chose the specific form of AGATE’s partnership model for the Program Manager in 1993. The AA made a decision

²¹ Short-Haul General Aviation/Commuter Element, Level II Program Plan, Sec. 9.6, January 1994

²² AGATE, Executive Safety Review Board, Operating Procedures and Guidelines, November 1996

²³ AGATE JSR Agreement, Section 20.01 and 20.02, limitations on foreign access and Commercialization Certifications

²⁴ Interview with John Newcomb regarding evolution of 7120.4 and 7120.5

launch three new programs utilizing partnership models being developed by the Commercialization Unit of NASA.²⁵ The partnership models were based on the R&D partnership models extensively used throughout the private sector, and organized in a formal program known as the Joint Sponsored Research Program (JSR). That program had a series of structured steps that copied the private sector method for creating an “operating” research and development partnership. An operating r&d partnership contains partners that agree to share costs of developing technology that has a direct interest to every member. The partnership is organized as a “project” with multiple levels of responsibility and control. All participants are required to be at some form of financial risk, and agree to equally share the intellectual property outcomes. The management of the partnership is vested with a third party “facilitator” that has no direct interest in the technology. The JSR model was based on use of Space Act Authority to provide the customization needed for each program or project.

The JSR program planning requirements follow essentially the same steps as the NASA practice for program planning, but tailored to add the additional steps and issues relevant to partnering. The additional partnering steps fell in three basic categories:

- **Needs Assessment: Partnership Value**

A needs assessment was first conducted to assure the program meet the criteria for a good partnership. At least half of the potential “partnerships” referred to the NASA JSR program staff were attempts to avoid the procurement system or seek funding for programs scheduled for closure.²⁶ The needs assessment asked basic questions such as whether the NASA manager had a clear plan with objectives that could be used to solicit partners, and whether those partners had compatible financial, operational and cultural practices.²⁷

- **Process Modifications: Steps Particular to Program Partnering**

A program partnership follows steps based on the approach that partners “plan and implement” together. This approach requires NASA fully prepare its own plan before engaging partners in a process that effectively modifies that plan for joint approval and implementation. This practice is common to program planning, except for additional steps in which partners are expected to commit resources to successfully implement the plan. The key elements of this modified process are:

- Preliminary Project Planning- Prepare a preliminary program plan that specifies goals, objectives, tasks, resources, outputs, organization and management processes. Use the preliminary plan to identify where and how partners can contribute to the program/project objectives. The planning identifies the mutual benefit to the other partners from potential involvement.
- Partner Solicitation & Selection- Use the preliminary project plan to solicit potential partners for mutual planning and information exchange sessions. Select potential partners based on clearly disclosed and consistently applied criteria.
- Joint Modification and Project Implementation- Execute the agreed upon program plan according to the agreement under the structures developed during the planning and structure stage. This stage includes an ongoing “evaluation” and change process from within the partnership.
- Closeout, Distribution and Conversion- Execute the program closeout according to a “closeout” element of the joint plan.

- **Management Requirements: Structures and Controls Particular to Partnering**

Project partnerships have the same basic management requirements as command and control based projects, but with modifications to provide for the risk and reward sharing agreement. Most of the management activities are structured as joint, with the senior partner having final authority to determine direction of the project. In the case of AGATE, NASA was that “senior” partner. Beyond the joint management activities, there are only four differences between a traditional program structure and a partnership-based structure.

²⁵ Three programs directed to utilize partnerships: AGATE, ERAST and RITA

²⁶ JSR Program Research Results prepared by Paul Masson

²⁷ JSR Program “Intake and Evaluation” form, prepared 1993

- Partnership Management- The structures and processes for joint-direction and management of the program. The level of participation and influence is normally tied to the level of resources, risks and rewards allocated among partners. The elements of partnership management include:
 - Strategic Governance
 - Management Organization and Processes
 - Technical Team Organization and Processes
- Output Distribution Management- The management of systems and procedures to capture outputs (hardware, software, patents, copyrights, etc) for protection and distribution among partners.
- Facilitation and Dispute Resolution- The use of some form of independent facilitation and dispute resolution to quickly resolve problems.
- Change Process- The governance and management systems to implement change within the distributed partnership structure.

Standard vs. Partnership Based R&D Programs Models

The summary comparison of the traditional NASA program models vs. a partnership-based model shows them to be fundamentally the same in terms of steps, and management elements.

- Policy- Both models address policy issues.
- Assessment- The partnership model includes a preliminary “assessment”.
- Process Requirements- The partnership model includes an additional three process elements; two designed to include partners in the planning process, and one designed to closeout the partnership in an orderly manner.
- Management Requirements- The partnership model includes four additional management elements designed to deal with the requirements of joint management processes.

Figure 3: Standard vs. Partnership Based Program Model

Partnership Program Model	Standard Program Model
Policy Context-Effectiveness Purpose Strategy Management Results	Policy Context- Effectiveness Purpose Strategy Management Results
Partnership Assessment	N/A
Process Requirements	Process Requirements
Formulate Preliminary Plan	Formulation Stage- Plan
Partner Solicit and Select	Formulation Stage- Identify Commercialization Opportunities
Joint Modification to Plan	N/A
Joint Approval	Approval
Joint Implementation	Implementation
Joint Evaluation	Evaluation
Closeout Distribution or Conversion	N/A
Management Requirements	Management Requirements
Human Capital	Human Capital
Partnership Management	N/A
Shared Resource Management	Resources Management
Shared Risk Management	Risk Management
Joint Performance Management	Performance Manage
Partnership Agreement Administration	Acquisition Manage
Shared Safety & Environmental	Safety and Environmental
Shared Security, Export Control & Foreign Involvement	Security, Export Control & Foreign Involvement
Shared Output Distribution	N/A
Facilitation & Dispute Resolve	N/A
Change Process	N/A

Partnership Based Program Model

The AGATE program model covered all of the basic NASA program requirements at the project level, modified with a number of steps necessary for partnering success.

Figure 4: Partnership Based Program Model

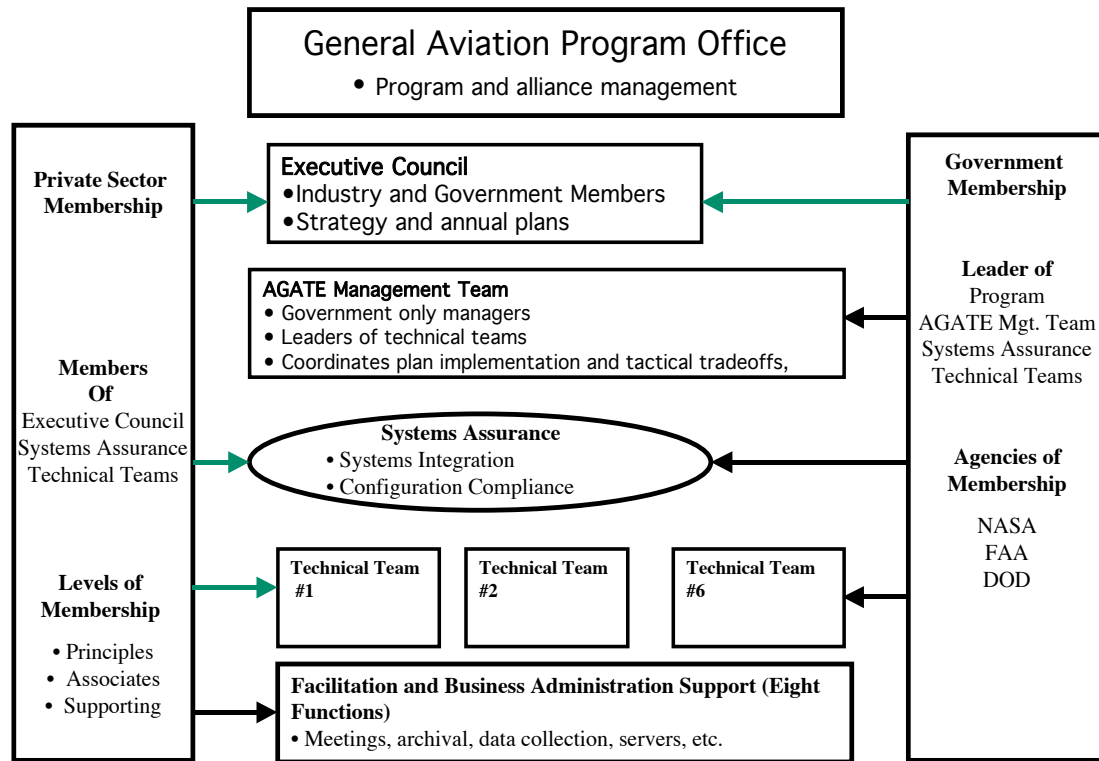
Integrated Model	Description and Coverage
Partnership Assessment	Six steps to assess value of partnership based model for program / project
Process Requirements	Process Requirements
Preliminary Project Plan	Formulate plan and secure preliminary approval
Partner Solicit and Select	Use preliminary plan to solicit and select partners; address commercialization and business opportunities
Mutual Plan and Structure	Formulation of joint plan and operating structure
Mutual Approval and Agree	Concurrent review and approval
Implementation	Implement plan under joint strategic and operational management
Closeout, Distribute, Convert	Implement planned closeout with distribution of results
Management Requirements	Management Requirements
Project-Human Capital	Project human capital needs assessment and fulfillment
Partnership Management	Joint management including systems engineering, technical teams, safety review
Resource Allocate & Manage	Joint financial, physical and human resources allocation and management
Risk Allocate & Manage	Allocation of risks per mutual plan, with ongoing review for risk identification and management
Performance Monitor & Manage	Joint performance management to objectives, milestones, tasks, budgets etc. with corrective management
Business Agreement Manage & Administration	Business agreement execution including acquisition management and integrated operations reporting
Risk Manage-Safety	Ongoing identification and alignment of risk management activities for safety, security, export control, foreign involvement
Output Distribution Manage	Collection, archival and distribution of outputs per agreement
Facilitation & Dispute Resolve	Neutral third party process facilitation and dispute resolution
Change Process Manage	Ongoing identification of changes with concurrent realignment or resources and lower-level teaming structure

AGATE Organizational Structure

The AGATE organizational structure was a hybrid of basic project command and control structures, with layers of working groups to coordinate decisions. NASA took the leadership role at each level, except for basic facilitation and business administration, while industry took a “membership” role at each level. The organization had six basic components:

- General Aviation Program Office (GAPO)- The NASA program office staffed by the Program manager, a deputy and secretary. GAPO was the overall “alliance” manager and had final authority to approve all plans.
- Executive Council- A senior level council composed of elected representatives from industry and designated government representatives. The Council’s primary function was to agree on strategy and priorities.
- AGATE Management Team- The Management Team’s primary function was to assure coordinated implementation of the annual plan. The team was composed of the GAPO personnel and government technical specialists that led six technical working teams.
- Systems Assurance- The systems assurance team was led by a Government specialist and composed of industry members representing each of the technical working teams. Its primary function was to support systems integration across technical teams and assures work was done to overall “configuration management.”

Figure 5
AGATE Alliance Organizational Structure



Legend: Green lines indicate “membership participation”
Black lines indicate “leadership” responsibility

- Technical Teams- A total of six technical teams were formed. Each team was led by Government specialists and composed of industry and academic members. These were the basic organizational units that prepared and executed annual technical plans to achieve the program's objectives.
- Facilitation/Business Administration- The facilitation function acted as a good-faith intermediary between the public and private sector members. The business administration function provided eight basic services necessary for a partnership-based program. Led by private sector managers, this function was delivered through by a non-profit private sector entity, and funded by both the public and private sector.

EFFECTIVENESS MEASURES: AGATE PROGRAM CONTEXT

Four Levels of Effectiveness Measurement

There were four levels of effectiveness that applied to the AGATE program over its lifetime of planning and implementation:²⁸

- Policy- Major principles that guide the justification all Federal programs.
- Department / Agency Strategy- Strategic goals to be accomplished or supplemented by all Agency programs.²⁹
- Large Organizational Unit- NASA Center (Langley, Ames, Glenn) level measures including their respective charters, developmental goals, and management system requirements.
- Program- Measures specific to a specific program (e.g. aeronautics knowledge advancement). The achievement of the targeted program outcomes must meet effectiveness requirements at each of the three higher levels.

Eight Measures of Effectiveness During AGATE Program

There has been a concerted effort across multiple administrations to continuously improve the operating performance of the Federal government. A review of the management initiatives launched over the past four administrations was synthesized into eight major effectiveness criteria, which were applied to the AGATE program.³⁰ These measures translate into specific management expectations of stakeholders at different levels of a given Federal program.

- Performance- Creation of measurable goals to be achieved through program plans, organization structures, and management structures with high quality, on schedule and within budget.
- Public Benefit without Private Preference- Creation of Program outputs designed to generate benefits to the American public without subsidy to private participants or control of the outcome by a limited number of organizations.
- Relevance- Definition of goals and objectives relevant to customer / user groups.
- Speed- Generation of results quickly and in forms that can be readily adopted by customer / users.
- Accountability- Creation organizational structures with clear responsibility and monitoring systems tied to specific performance measurements. The structures and systems hold Program and task level managers accountable for all Levels of objectives.
- Cost- Reduction of costs in all categories of program content and management.
- Flexibility- Use of legal authorities, organizational structures, and decision processes to respond to changing needs from policy, management, and research & development finding.
- Institutional Development- Development of institutional capacity for further research and development support. Development of these capacities includes improved human capital, facilities, and new knowledge

²⁸ Derived from interviews with Bruce Holmes, Sam Morello, and David Trinkle (OMB)

²⁹ NASA Strategic Management Handbook, as revised NPG 1000.2, Washington, DC, 2000

³⁰ A Report to the 43rd President and 107th Congress: Transitioning to Performance-based Government, November 2000

Assessment Framework

The cumulative program effectiveness measures generated at different levels of oversight create a single model for the AGATE program assessment. The format is designed to mirror the evolution in performance measurement summaries developed under the last two administrations.^{31 32}

Figure 6: Assessment Framework

MEASURES	Qualitative Rating (High, Medium or Low)	Feedback from Participants of Effectiveness regarding Policy, Strategic, Organizational Unit and Program/Project Levels
Performance		
Relevance		
Benefit w/out Preference		
Accountability		
Cost		
Speed		
Flexibility		
Institutional		

Assessment Rating

The effectiveness feedback is summarized qualitatively at one of three levels (high, medium and low). The qualitative rating was compiled in from the five sources identified in the Methodology. Performance and Accountability assessments were heavily based on interviews from NASA managers³³, annual “commercialization” performance reports, annual performance audits, and the independent OIG review. Relevance, Cost and Speed assessments were heavily based on closeout reports and annual “surveys” conducted of both industry members and NASA technical team leaders. Benefit Without Preference was heavily based on the annual commercialization report. Flexibility and Institutional assessments were heavily based on the interviews with NASA technical team leaders and business managers.

³¹ 5th Year Report on Re-Inventing Government, op. cit.

³² Program Assessment Rating Tool (PART) explanation, provided by David Trinkle to Paul Masson for interview.

³³ See Appendix A for interview guide

EFFECTIVENESS: PARTICIPANT CONCLUSIONS

Summary

The participants rated AGATE as achieving its primary objectives and rating well on effectiveness in most areas, with high measures for relevance, cost, speed and public benefit, but lower measures for institutional fit and flexibility at dealing with the larger NASA organizational structure. This pattern mirrors private sector surveys and represents a tradeoff between the benefits of tailoring a program using partnering, versus the changes necessary within the institutional structure to support such tailoring.

The technical managers generally rated the effectiveness high when assessed against the program's stated goals. The area of stretch goals is where the technical participants rated AGATE lower. Technical participants sought more integrated flight tests, but recognized that integration was a tradeoff for a desired "decentralized" approach permitting work teams to operate independently on selecting specific technology targets.

The business managers at NASA rated the program medium to low, focusing on the difficulty of implementing a program structure that contained more tailoring than most NASA LaRC programs.

The summary of effectiveness responses is provided in the following table.

Figure 7: Summary of Effectiveness Assessments

MEASURES	Qualitative Rating	Effectiveness at Policy, Strategic, Organizational Unit and Program/Project Levels
Performance	High	Performance was achieved at all levels. The decentralized structure of the alliance made it difficult to achieve integrated flight tests.
Relevance	High	The relevance of program/project outputs scored high by the industry end-users and the FAA partners. Disagreement over relevance was limited to specific technology targets rather than the overall program/project approach.
Benefit w/out Preference	High	Public benefit without private preference scored high with all participants due to the focus on creation of technology standards rather than specific technologies.
Accountability	Medium	Accountability was achieved at the Policy, Strategic Levels. Financial accountability was achieved at the Center and Program level, but technical accountability was reported as inconsistent for some of the work-teams at the program/project level. This inconsistency at the program/project level created questions of accountability at the Center level.
Cost	High	The cost effectiveness was considered high at all levels. The program secured cost sharing from private sector partners and organized highly effective leveraging agreements with other NASA programs (SBIR) and the FAA.
Speed	High	The speed of tasking and undertaking work was considered high, when compared to other Federal program/project forms. The speed of program “formulation” was the only negative rating. This was attributed to the need to secure “agreement” with partners before proceeding.
Flexibility	Medium	Flexibility was achieved at the Policy, Strategic and Program/Project levels. Changes in national priorities, NASA’s strategy and project targets were incorporated into the program. This flexibility, however, caused difficulties at the Center level need for consistent program/project management.
Institutional	Low	The program worked with a limited section of the Center level institutional structures and built certification rather than research knowledge in the research and technology competencies. Center level business managers found the program required difficult modifications from standards procedures.

Performance

The program achieved its performance goals at all of the four measurement levels. NASA performance goals are officially classified using similar terminology that denominates “levels” 1 through 3 for performance, with level 1 representing policy and strategic goals, level 2 representing organizational unit goals and level 3 specific program / project performance measures.

The Policy and Strategic goals were achieved by the re-creation of links between the aeronautics research and development capabilities of the country (NASA, FAA and academia) and the private sector general aviation industry. Commercial and academic participants in an annual commercialization survey confirmed ongoing research links based on one of fourteen “standards” developed by AGATE program.³⁴ Examples of such work include avionics advances for additional pilot information providing new safety; adoption of noise prediction software permitting better design to minimize noise; creation of new methods for composite materials use that is now being adopted by both large aircraft manufacturers and the military.

Policy and Strategic unit goals were also achieved by changing technical work plans and priorities. The changes were possible due to the organizational structure of the program that permitted adding and dropping technical teams and creating special “task element” teams by mutual agreement among the members. Three examples of this shift were:

Security- The addition of free flight tests for the FAA over the Atlanta Olympics in response to the need for increased security. These tests were accomplished by having the FAA sign into the agreement as an AGATE member; fund a separate task within a technical team; and secure cost sharing from the private sector to create the “standards” behind the technology necessary to support free flight.³⁵

Safety- The creation of an aviation safety initiative resulted in the funding by NASA’s aviation safety program of a new team within AGATE addressing safety issues specific to the general aviation industry.

Noise- The increase in concern regarding noise resulted in the creation of another task element team with the Integrated Design and Manufacturing technical team focused solely on noise prediction and limitation within general aviation aircraft. The resulting software code has been adopted and is portable across multiple platforms, and was reported by AGATE members as also being applied to commuter aircraft design.

The program met its objectives at the Organizational Unit and Program level (Level 3), after in Executive Council and the Program managers. These Level objectives were grouped by technical area, with the largest number of objectives met in the area of integrated design and manufacturing followed by flight systems. The area that saw the least number of objectives met was in integrated flight platforms. One of the “stretch” goals of the program was to integrate advances from the teams into aircraft for flight demonstrations. For planning purposes, the evolution of technologies was grouped sequentially into a “reference” point designated reference aircraft “A”, “B” and “C”. The program did not succeed in securing sufficient integration of technologies to successfully launch all of the reference aircraft. In this sense, the AGATE model, with its decentralization and separation of tasks, was not effective as delivering demonstration flights incorporating integrated technology.

³⁴ Keith Gale, AGATE Commercialization Report, 1995-2000

³⁵ Free flight is the ability of aircraft to operate safely in regulated air space without the need for a central air traffic control.

Relevance

The Program received high ratings for the relevance of its work from industry and user participants based on an annual survey. The AGATE program conducted an annual survey among members of the most value received from participation. The highest value ranked by the members was the “organizational” structure of the program, which brought together the diverse elements of aeronautics research in the country focused on the needs of the General Aviation aircraft. Financial value ranked at the bottom of the survey, reflecting the small amount of money often allocated across the tasks. The relevance value was concentrated in three areas:

Focus on End-User Related Standards- The program focused on generating Guidelines for Standards and Certification (GS&C). The relevance of these standards was assured by the open participation by any US general aviation company. The requirement for cost sharing among participants assured that only those “standards” broadly supported by the industry were undertaken during the program. The participation by these stakeholders in defining the technical plans, tasks and deliverables assured they were relevant to members.

Tom Bond of the Glenn Research Center led work in Icing Systems and stated:” This vehicle offered more potential to work with the end user than any other vehicle I have ever used. We became more closely coupled to the final state of our technology use, and I found that very valuable....It serves an excellent purpose for NASA because it balances our work: a certain part into the next generation, a certain part into the near term exploratory, and a certain part in the 3 to 5 year impact.”³⁶

Link to FAA Certification Requirements- The legal authority and organizational structure of AGATE permitted a series of technical exchange links between AGATE members and the FAA. These links were judged by representatives from NASA, the FAA and members to be one of the most effective features of the AGATE program. The link took the form of a working group of Federal Aviation Administration (FAA) certification personnel from around the country, organized by their respective disciplines matching the field of technical research within AGATE. The group was known as “AIR AGATE” and met collectively with industry technical counterparts within AGATE to review the type and quality of information necessary to establish standards that could support possible certification guidelines. The creation of a national group provided for an increased level of consistency when applying such standards and certification guidelines by the FAA. The ability of industry specialists to collectively discuss technical standards with the FAA permitted private corporations to effectively plan product innovations for review according to FAA expectations. This, in turn, resulted in lower certification costs and better conformance to FAA certification regulations.

Private Sector Investment- The program eventually attracted more private sector investment than originally required. The program was designed to require dollar for dollar matching of research funding. An audit of nine private sector members indicated that five of the nine audited members exceeded their obligation to match Federal research funding by a collective 19.3%.³⁷ The private sector members reported the rationale for additional investment as the value of the standards for industry growth and certification cost control.

Public Benefit Without Private Preference

The program participants and reviewers were in agreement that public benefit was achieved without private preference. This was achieved through three mechanisms:

Creation of Standards for Competition- AGATE research results took the form of technical reports designed to generate “pre-competitive standards”. The reports, called

³⁶ Paul Masson interview with Tom Bond

³⁷ Conclusions From Review of AGATE Audits: Total AGATE Member Resource Matching for Project Years 1995-2001, prepared by Paul Masson and Bill Lennett, Contractor Report L-70960D

Guidelines for Standards and Certification (GS&C), were made available to any US general aviation corporation willing to share in the AGATE program cost of their creation. The guidelines acted as the equal playing field for building new products among competitors, without benefiting any single company that would control the guideline.

Organization Permitting Unlimited Participation- The AGATE organization structure permitted participation by all sizes and types of organizations. Three classes of membership were created:

- Principal- Designed for large corporations willing to meet the minimum 50-50 cost sharing guideline with rights to all AGATE reports.
- Associate- Designed for small corporations willing to pay less than the minimum 50-50 cost sharing, and receive limited rights to AGATE reports.
- Supporting- Designed for universities, corporations and individuals unable to cost share, but willing to pay a nominal membership fee in return for rights to a small number of systems reports.

The conditions of participation required Principal and Associate members to develop commercial product innovations based on AGATE developed standards.³⁸ Foreign participation was restricted.

Intellectual Property Terms- The AGATE technical reports (GS&C's) were defined as a class of intellectual property known as "data rights." The data rights terms required the reports be released to the public in five years, or earlier if agreed to by the members. In addition, the property rights on the reports permitted them to be "traded" between the various technical teams within the overall AGATE Alliance.

The technical areas of the reports included, among other items, crashworthiness design guides for safer aircraft; avionics certification standards permitting new information tools in the aircraft for safer aviation; and composite materials qualification methodologies.

Accountability

Accountability was perceived differently by the participants, depending on their particular level of responsibility and systems normally used for project monitoring.

Policy and Strategic level accountability was achieved via regular Program reviews at NASA headquarters. This was accomplished through annual reviews of the program with concurrent reporting to goals and milestones.

Center level and Program level accountability received a mixed review. The institutional program/project monitoring managers at the Langley Center did not rate the accountability high within the program. There was a mix of positive and negative factors that contributed to this question of accountability:

Positive: Clear Technical and Business Administration System- The AGATE program created a business administration and monitoring system customized to the particular structure of its project. This system was codified in an Administrative Management handbook that combined the JSR Agreement, the JSR program guide known as the Program Information Package (PIP), and a detailed business management guide known as the Business Operating Handbooks (BOH). Within the JSR Agreement appendices were details of required annual technical planning, monthly reports, and compliance approval systems. The overall administration of the project was assigned to the NASA LaRC Project Controls Branch.

Positive: Regular Audits and NASA Technical Review- The program had a built annual series of member audits and provisions for special reviews. A total of nine audits were completed on members during the length of the program. The audits found no major or misrepresentation by members. In addition, the OIG undertook a separate management review, resulting in a recommendation to change one operating procedure.

Negative: Withdrawal of PCB, Creation of New System- The NASA LaRC Project Controls Branch (PCB) withdrew support of the program after one year, citing the Federal

³⁸ AGATE Joint Sponsored Research Agreement, Membership Category, Sec. 4.04

downsizing and lack of personnel to support the AGATE program. The PCB withdrawal required creation of a separate business administration and accountability system. The AGATE private sector members created a non-profit corporation to assume the majority of PCB's support functions. The non-profit was chartered to support the AGATE Alliance and was known as the AGATE Alliance Assn., Inc. (AAAI). This was perceived as losing Government monitoring over the project, even though AAAI was required to provide all monitoring and review requested by the Government.

Negative: Inconsistent Technical and Business Reporting Enforcement- The program experienced incomplete or late technical and business reporting throughout its technical teams. The incomplete reporting required pro-active follow-up by Government technical leaders and business administration personnel. The additional follow-up often took the form of verbal and e-mail confirmations of information required for program oversight. This resulted in a gap between the detail of information maintained in the central administrative archive, and that found in files of the technical team leaders.

Cost

The AGATE program was completed with substantial contributions from the private sector and close coordination with other Federal agencies and small business programs. The resulting leveraging generated a program in which NASA program funding paid 49% of the total cost over seven years. The program received \$69 million over eight years, with \$40 million spent on direct technical research and \$29 million systems assurance, program management, and alliance management. Of the approximately \$140 million total AGATE expenditures, \$40 million were paid for by the private sector, and another \$34 million levered from FAA, DOD, and SBIR/STTR programs.³⁹

There were multiple mechanisms that made this cost effectiveness possible:

Program Formulation and Legal Authority- The program was initially formulated to operate as a cost-sharing program with the private sector. The use of Space Act Authority within the Joint Sponsored Research Program permitted NASA to create "partnership" categories with multiple criteria for cost savings.⁴⁰ The authority also permitted NASA to create participation categories for small businesses to offer internal research in exchange for, access to the AGATE technical reports (GS&C's).

Close Program Coordination: SBIR/STTR- The AGATE program managers created a closely coordinated plan between AGATE technical topics and those due for announcement in the SBIR/STTR programs.⁴¹ This coordination permitted small businesses to undertake research relevant to the topics selected within AGATE.

Clear Cost Sharing- The program developed a detailed set of cost-sharing conditions that went beyond the OMB guidelines. These conditions specified the particular forms, levels and criteria for cost sharing.⁴² One form of contribution permitted small businesses to present proprietary technical reports as an "in-kind" contribution if agreed to by a given technical team. In addition, the program sought and received one-time approval to use Space Act Authority to permit background intellectual property (IP) to be used as cost sharing. However, only three background IP contributions were made, all in small dollar amounts. The lack of use of background IP contributions was attributed to the strict criteria, which copied private sector IP valuation criteria for such IP.

Verification Criteria and Process

The program developed a process for verifying contributions by non-federal members. The process required annual submission of planned financial contributions by all non-federal members. This submission, known as the annual "in-kind cost-sharing" report,

³⁹ Total AGATE Program Funding Report, prepared by Tim Warner, NASA LaRC

⁴⁰ AGATE JSRA, Membership Category, Sec. 4.04, op. cit.

⁴¹ Interview with Thayer Sheets, NASA LaRC SBIR Program Manager

⁴² AGATE JSRA, Allowable Resource Contributions (Attachment 9), In-Kind Resources Valuation Methods (Attachment 10), Financial Procedures and Allowable Expenses (Attachment 14), op. cit.

was reviewed by the independent facilitator for compliance with the cost-sharing criteria. Those companies that were not within compliance or lacked supporting information were required to correct their contributions or be subject to loss of membership rights. Companies that submitted incomplete or financial information to support their planned in-kind cost sharing were subject to one of the annual audits. (See Accountability)

Speed

The overall speed of the program was rated high due to the speed of individual task planning and implementation. The program was described as “slow” in the formulation stage due to lengthy meetings with private sector participants to agree upon specific technical plans. Specific areas mentioned in the interviews and closeout reports included:

Faster Project Startup- Startup activities beyond the planning were faster due to the time spent in up-front agreements with members and legal authority. The JSR Authority permitted development of “Annual Task Plans” that were attached to a master agreement. The task plans could be initiated once the master agreement had been signed.

Rapid Strategic Redirection- Strategic re-direction was faster due to the combined operation of the Executive Council and the ability to change task statements without re-negotiating the master partnership agreement.

Slow Initial Program Formulation- The participant structure and motivation coupled with the team process emphasizing consensus reduced the speed of program planning and startup, except in the area of procurement execution. Overall, the program was slower to create plans and launch than a comparable government planned program.

Task Execution and Outputs- The legal authority and participant motivation of AGATE increased its effectiveness at task execution and the ability to adjust when necessary. The legal authority permitted the creation of a task funding process that was completed within one-half the normal time of procurement. The participant motivation of AGATE, with its cost-sharing feature, was an incentive to finish tasks on time and budget, since the cost of extensions and overage were equally born by both the Government and private member.

Flexibility

The program received positive reviews for its strategic and operational level flexibility, but that flexibility caused difficulties working within the Center level management systems.

Change Process- The key to change was in the terms of the legal agreement, which permitted the program to be re-defined and re-tasked every year. The agreement was structured to address long-term research collaboration issues, rather than a single research and development program for a fixed period of time. The changes were executed by mutual agreement through procedures established for the Executive Council and Technical Teams.⁴³ Differences over direction of change were resolved by involvement of the Facilitator.⁴⁴

Competitive vs. Collaborative Processes- The legal agreement provided for the introduction of competitive processes when the basic collaborative could not produce agreement. The competitive process was defined by NASA following modified procurement procedures and was known as a Competitive Tasking Notice (CTN). The process was invoked twice, with split agreement among members as to the success of the process.

Separate Technical Teams with Ability to Trade- The Technical Teams constituted the core organizational unit for all technical work. The intellectual property rights of the legal agreement provided that the results of each team were “separate” from other teams. However, the legal agreement also permitted the teams to “collectively” trade information and exchange intellectual property rights, thereby creating a form of internal market for

⁴³ JSRA, Executive Council Operating Procedures (Attachment 3), Technical Council Operating Procedures (Attachment 4).

⁴⁴ JSRA Legal Agreement, Alliance Facilitation (Attachment 5).

exchange. In this manner, the teams were flexible in judging what was and was not of value in creating integrated systems.

Flexibility vs. Program Management Structures- The highly codified procedures for the change processes and working teams translated into inflexibility at the local Center level. It became difficult for Center level management to institute changes in management systems and bring the AGATE Program in alignment with those changes. (See Institutional below)

Institutional Fit and Development

The program received mixed or negative assessments from Center level managers responsible for assuring the program fit within overall institutional standards and structures. Most of the individuals interviewed understood that the program was intentionally designed to operate differently. However, that understanding did not address their particular issues, which generally fell into three categories:

Center Level Management and Business System Fit- The program was initially designed and launched without developing some of the standard elements of program/project management evolving at the Langley Center in the early 1990's. These elements, known collectively as the Langley Management System (LMS) called for certain minimal criteria in program/project design and implementation. Some of those elements addressed issues such as configuration management, technical output control, acquisition management, safety assurance, and logistics management. Those elements were not explicitly addressed in the AGATE program during its formulation. The core conflict stems from AGATE's design of "processes" to create ongoing technical programs rather than a fixed research and development program.⁴⁵ The secondary conflict stemmed from the use of Space Act Authority to create a task financing process that was a modification of cooperative agreements, but without the documentation desired by procurement managers. One LaRC procurement manager described AGATE as "...not the way to do business."

Center Level R&T Competency Relevancy- The AGATE model of strategic planning, task staffing and technical output definition did not generate results relevant to the R&T competencies within NASA Langley. The technical strategy of AGATE was focused on rebuilding general aviation advanced technology links between government, industry and academia. This very objective limited the creation of new knowledge that would have been relevant to the NASA R&T competencies. In addition, the General Aviation category was not a high priority with individual researchers. "The feedback I got was that the research was not the kind... they (the researchers) wanted to do and that (the researchers) were expected to lead a fractious group of people."⁴⁶

Center Level Capabilities Development: Facilities, Personnel, and Knowledge- The program did not create new facilities or knowledge that added to the Center's long-term capabilities. The project staffing via participating members rather than Center based contractors reduced the close-in knowledge transfer that occurs between government contract technical monitors and their contractor counterparts. The definition of technical outputs as "guidelines for standards and certification" meant that the information contained in those guidelines was rarely new knowledge, but rather the configuration of the correct knowledge necessary to deploy a new technology through the FAA certification process. Finally, the bulk of the work was undertaken at facilities of corporate and academic members, with the exception of drop tests conducted at Langley's facility.

⁴⁵ Advanced Subsonic Program Element Plan, op. cit.

⁴⁶ Interview with Doug Dwoyer

Appendix A- Interviews and Interview Questionnaire

Purpose and Scope

Interviews were conducted with individuals at two levels of influence:

- Policy- Federal and NASA policy regarding science/technology program use of public/private partnerships.
- AGATE Program Design and Implementation- Participants in the design and implementation of the AGATE program.

Schedule

Interviews were conducted in three rounds. The first round was focused on program designers and participants, and was completed between August and November 2002. The second round was focused on NASA managers responsible for program & project policy at the Agency-wide and center level, and was completed between January and March 2003. The third round was focused on Federal managers with influence on the standards for management effectiveness, and was completed between April and June 2003.

Interview Guide(s)

Interview guides were developed for the two separate groups of interviews.

Policy

1. Support Partnership Authorities and Business Practices- What, if any, were the reasons that motivated you and your colleagues to support the effort to adopt legal authorities and business practices permitting federal technology alliances such as AGATE etc.?
2. Pursue Management Effectiveness- To what extent, if any, was improved management effectiveness a motive in supporting the adoption of such authorities and business practices. We are defining management effectiveness as the ability, as a minimum, to achieve federal R&T program goals more 1) quickly, 2) with fewer resources, 3) without political, policy or program conflicts, and 4) without burning out the human resources.

Program Design Implementation

1. How would you compare the design and implementation to
 - A. FAR based contract for a demo
 - B. University led consortia
 - B. Industrial cooperative agreement with a vertically integrated team
2. What was more effective, if anything, about AGATE?
3. What was less effective, if anything, about AGATE?

Appendix A- (Con't)

Interviews- Policy and Strategy

Name	Former/Current Position	Policy/Strategy Role
Ruth Martin	Director for Program Integration	Link between AGATE Program objectives and NASA LaRC Aeronautics Program Strategy
Doug Dwoyer	NASA LaRC- Assoc Director R&T Competencies	Link between supplying R&T competency expertise to AGATE and measures of R&T competencies groups
Sam Morello		Link between detailed AGATE program objectives and needs of both Program Integration and R&T Competencies
Ambassador James R. Jones, formerly Congressman James R. Jones (D-Ok)	Counsel Manatt, Phelps Co-Chair Manatt, Jones Global Strategies, LLC	Policy regarding NASA charter and budget, Chief of Staff President L. Johnson (1963-68), basis for policy to support strategy linking technology programs to technology transfer
Frank Penaranda	NASA Retired, formerly Chief of Technology Transfer Programs	Policy regarding technology transfer via partnerships,
Kevin Barquinero	President, Knowledge Sharing Systems, formerly Technology Commercialization@ NASA HQ	NASA Joint Sponsored Research Partnership Program design and implementation; liaison to NASA Aeronautics for selection of AGATE, ERAST and RITA alliances
John Newcomb	NASA Consultant	Develop management effectiveness criteria for NASA's Advanced Program and Project Leadership (APPL)
Paul Coleman	University Space Research Associates	Develop strategy for creation of institutional partnering programs at NASA
David Trinkle	Office of Management and Budget	Evolution of policy regarding measurement of program effectiveness, link to creation of Program Assessment Rating Tool (PART)

Appendix A (Con't)

Interviews- Program Design and Implementation

Name	Current Position	Design & Implement Role
Bruce Holmes	NASA LaRC-SATS Project Office	Manager- LaRC General Aviation Program Office (GAPO)- Federal manager of AGATE
Mike Durham	NASA LaRC- SATS Project Office	Dpty. Manager- GAPO- Deputy manager for AGATE 1996-1999
Sally Mauldin	NASA ARC-Chief Counsel	Lead LaRC attorney on drafting of AGATE legal agreement
Steve Hanvey	President- Piaggio, USA	Leader of AGATE Executive Council-1995-1996
Ed Hooper	Toyota Motor Sales, USA- Aircraft Development	Beech representative to AGATE Program planning task force- 1992-1993
Sandra Ray	NASA LaRC- Dpty. Director Procurement	Procurement representative to AGATE business management design team (N-Team)
Rosemary Froelich	NASA LaRC- Head Grants and R&D Studies Branch	Procurement liaison from 1996 to 1999
Karen Reilley	NASA LaRC- Office of Chief Counsel	GAPO and AGATE program government counsel 1997 to 2001
Sandra Smalley	NASA HQ- Financial Management	AGATE Business Administration Manager via LaRC PCB- 1995 to 1996
Michelle Cohoon	NASA LaRC- Financial Management	AGATE Business Administration Manager via GAPO 1998-1999
Tim Warner	NASA LaRC- Management Support Office	GAPO Program Analyst for AGATE- 1997 to 2001
Jack Sheehan	AGATE Alliance Association, Inc. (AAAI)- ED 1997-2001	AGATE business administration services 3Q-1997 to 2001

Tom Bond	NASA GRC- Icing Branch	AGATE Icing Protection Systems Technical Team Lead 1995-1998
Paul Stough	NASA LaRC- Crew Vehicle Integration Branch	AGATE Flight Systems Technical Team Lead- 1995-1997
Tom Freeman	NASA LaRC- Mechanics and Durability Branch	AGATE Integrated Design and Manufacturing Team Lead- 1996 to 2001
Ted Bright	NASA LaRC	Executive Safety Review Board
Walt Green	NASA LaRC	Systems Assurance Workpackage Leader- 1997-2000
Thayer Sheets	NASA LaRC- Technology Commercialization Program Office	NASA SBIR Program Lead at LaRC

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28. Dwoyer comment: Dwoyer went on to say "The feedback I got was that the research was not the kind... they (the researchers) wanted to do and that (the researchers) were expected to led a fractious group of people. There was little communication of the detail of what the technical teams were debating.... and this constituted an abnormal business practice." (reference Aug 29, 2002 interview)

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14. ABSTRACT This report describes the collaborative program model chosen to implement an aeronautics research and technology program from 1994 through 2001: the Advanced General Aviation Transport Experiments (AGATE) Program. The Program had one primary objective: to improve the ability of the General Aviation industry to adopt technology as a solution to fulfill public benefit objectives. The primary objective of this report is to assess the program's ability to meet a combination of "effectiveness measures" from multiple stakeholders. The "effectiveness" of any model forms the foundation of legitimate questions for policy makers and professional federal managers. The participants rated AGATE as achieving its primary objectives and rating well on effectiveness in most areas, with high measures for relevance, cost, speed and public benefit, but lower measures for institutional fit and flexibility at dealing with the larger NASA organizational structure. This pattern mirrors private sector surveys and represents a tradeoff between the benefits of tailoring a program using partnering, versus the changes necessary within the institutional structure to support such tailoring.						
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